Statewide Dual Credit Learning Objectives for Introduction to Probability & Statistics (MATH 1530)
(Statistics #3136)

Appropriate types of samples and sampling methods

- Recognize whether a study is using simple random, systematic, stratified, or cluster sampling.
- Recognize the following methods of poor sampling: judgmental, convenience, and voluntary.
- Obtain a simple random sample using technology or tables.
- Distinguish between an Experiment and an Observational Study.
- Define and distinguish between non-sampling error and sampling error.
- Discuss how bias can affect the outcome of a study.

Appropriate representation of data

- Understand the term "variable" and differentiate between the data types: measurement, categorical, univariate and bivariate.
- Explain what is meant by "frequency distribution."
- Create a frequency distribution from a list of quantitative and qualitative data.
- Analyze a quantitative frequency distribution table by finding the class width used, sample size, and class midpoints.
- Calculate the relative and cumulative frequencies from a quantitative frequency distribution table.
- Calculate relative frequencies for a categorical frequency distribution table.
- Construct a histogram from frequency distribution table.
- Construct and/or interpret the following statistical graphs: Histogram, Scatterplot, Pie Chart, Bar Graph, Pareto Chart, Time series, Stem and Leaf plot, Dot plot, and Box plot.
- Interpret the shape of the distribution from a histogram (i.e. symmetrical, skewed, uniform, and bimodal).
- Identify why a graph might be misleading.
- Compare strengths and weaknesses of each type of statistical graph.
- Compare the distribution of two or more data sets that have used various graphical tools.

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Measure of Center and Variation

- Understand the measurements of center such as mean, median, and mode.
- Understand the measurements of spread such as range, variance, and standard deviation.
- Understand the effects of outliers on the measurement of center and measurement of spread.
- Calculate the mean and median using a set of data.
- Recognize the mode from a set of data.
- Calculate mean of a frequency distribution such as GPA and weighted grade.
- Recognize the mode from a frequency distribution.
- Calculate range from a data set.
- Calculate and interpret the standard deviation from a set of data with or without technology.

Probability and Statistics

- Explain the difference between empirical, theoretical, and subjective probability.
- Understand the concept of randomness (i.e. flipping a coin, rolling a die, drawing a card from a standard 52 card deck).
- List the elements of events and the sample space from an experiment.
- Find basic probabilities using the definition of probability.
- Use tree diagrams, Venn diagrams, and/or lists to solve probability problems where appropriate.
- Explain the Law of Large Numbers.
- Calculate and interpret probabilities using the complement rule, addition rule, and multiplication rule.
- Calculate and interpret conditional probabilities.
- Identify events as mutually exclusive or not mutually exclusive.
- Identify events as independent or dependent.
- Discuss the differences in the ways probabilities are calculated when events are mutually exclusive versus not mutually exclusive.

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- Discuss the differences in the ways probabilities are calculated when events are independent versus dependent.
- Explain the difference between mutually exclusive events and independent events.

Discrete Probability Distribution Objectives

- Identify the random variable in a probability experiment.
- Distinguish between discrete random variables and continuous random variables.
- Create a simple probability distribution for the values of a discrete random variable.
- Create a probability table for a discrete random variable.
- Use a probability function to determine probabilities associated with a discrete random variable.
- Create a probability histogram based on a probability table.
- Calculate and interpret the mean/expected value, variance, and standard deviation of a discrete random variable.
- Define and recognize discrete binomial probability distribution.
- Understand proper notation and calculate binomial probabilities.
- Calculate the Mean/Expected Value, Variance, and Standard Deviation for Discrete Binomial Probability Distributions.
- Use both range rule of thumb and probabilities to determine unusual values for the random variables.

Normal Probability Distribution

- Explain the characteristics of why the normal distribution is so important.
- Use area under a probability density curve to find probabilities for two different continuous random variables (the uniform distribution and the normal distribution).
- Know what “standardizing” data means so that the z-table can be used if the data are normally distributed.
- Calculate and interpret a z-score.
- Given a histogram from raw data determine if the distribution is a normal model.
- Understand the Empirical Rule and the general properties of the normal distribution. (i.e., 100% is the total area under the curve, exactly 50% is to the left and right of the mean, it is perfectly symmetric about the mean).

- Use the Z-table or TI-83/84 calculator to find area under the curve for any normal distribution model (left, right, between).
- Use the Z-table or TI-83/84 calculator to find percentiles, quartiles, or any other numerical value of X for a specified area under the curve for any normal distribution model.

Sampling Distributions and the Central Limit Theorem

- Describe the characteristics of the distribution of the sample mean: normal population.
- Describe the characteristics of the distribution of the sample mean: non-normal population.
- Describe the characteristics of the distribution of the sample proportion.
- Understand the impact of sample size on sampling variability.
- Understand the Central Limit Theorem and conditions to apply.
- Apply the Central Limit Theorem to normal and non-normal populations and compute probabilities of a sample mean.

Estimates and Sample Sizes (Confidence Intervals)

Estimating a Population Proportion p

- Calculate sample proportion.
- Understand that the sample proportion is the best point estimate of the population proportion.
- Find critical values $z_{\alpha/2}$ for a given value of α.
- Calculate the margin of error using sample statistics.
- Use a sample proportion to construct a confidence interval to estimate the true value of a population proportion.
- Interpret a confidence interval in context.
- Understand the effect of changing the confidence level and/or the sample size on the width of the confidence interval.
- Verify the conditions are met for estimating a population proportion.

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- Write a confidence interval in 3 different forms (point estimate plus/or minus margin error, interval notation, set notation).
- Find the best point estimate and the margin of error when given a confidence interval.
- Know how to find the sample size necessary to estimate a population proportion.

Estimating a Population Mean: σ Known and Not Known

- Understand that the sample mean $\bar{x}$ is the best point estimate of the population mean μ.
- Know the difference between the sample standard deviation (s) and standard error of the mean $\left(\frac{s}{\sqrt{n}}\right)$.
- Find critical values or either $z_{\alpha/2}$or $t_{\alpha/2}$ for a given value of α and degrees of freedom depending on if sigma is known.
- Calculate the margin of error using sample statistics.
- Use sample data to construct a confidence interval for estimating the value of a population mean, and interpret such confidence intervals.
- Write a confidence interval in 3 different forms (point estimate plus/or minus margin error, interval notation, set notation).
- Find the best point estimate and the margin of error when given a confidence interval.

Hypothesis testing Objectives

- Identify the claim in a problem.
- Determine the appropriate null and alternative hypothesis when presented with a problem.
- Determine if a test is left - , right - or two-tailed.
- Understand and list the assumptions for a z-test and t-test.
- Calculate critical values for tests involving a single proportion, a single mean, and difference between two means.
- Find p-values for *z* test statistics using a z-table or technology.
- Find p-values for *t* test statistics using t-table or technology.

- Determine whether or not to reject or fail to reject the null hypothesis using both the traditional and p-value methods.
- Conduct hypothesis testing for single proportion, single mean, and the difference between two means.
- Draw conclusions and make inferences about claims based on hypothesis testing.
- Explain Type I and Type II errors.
- Distinguish between independent and dependent sampling.
- Test hypotheses regarding the difference of two independent means (assume the variance are not pooled).

Linear Regression and Correlation

- Understand the assumptions of linear regression.
- Demonstrate the ability to identify the independent/explanatory variable (x) and the dependent/response variable (y).
- Demonstrate the ability to draw a scatter diagram, identify the type of relationship that exist between two variables and find the correlation coefficient either using a technology or the traditional method (formula).
- Find the line of best fit and interpret the coefficient of determination (as well as effects of confounding variables).
- Determine if line of best fit is statistically significant.
- For a given value of x, find the appropriate estimated value of y.
- Understand the difference between practical and statistical significance.
- Understand that correlation does not apply causation.
- Understand the difference of interpolation and extrapolation.
- Understand the possible problems of extrapolation.
- Calculate a residual using the line of best fit.
- Perform residual analysis to check assumptions of regression.